Reflections on 40 Years of Research and Telemetry: Where Will the Next Generation of Biologists and Technology Lead Us?

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Forward thinkers spend less time contemplating how far they've come than how far they have to go. In fields related to research and technology this is probably especially true, where we spend more time thinking about the next giant leap we prepare to take rather than the first baby step taken. It seems, however, that as I work my way toward the end of a career I often find myself in that nostalgic mindset to that place in the good old days (that seems like yesterday) lost in thoughts of "…wow, I can't believe that's how we used to…!"

A young Jim Watson assisting with deployment of a VHF transmitter on a prairie falcon on the Pawnee Grasslands.

I grew up on the plains of Colorado where the annual cycle of nesting Swainson's hawks and wintering rough-legged hawks sparked my interest in elementary school. Where do they go? Do the same birds return every year? I was fortunate that my father was an aerospace engineer/ham radio operator/basement tinkerer with a keen interest in promoting my interest in raptors. The question was – how could he combine birds and electronics? By the time I reached junior-high school in 1971 there were only a few companies that manufactured VHF transmitters for avian use. My father was contacted by Al Harmata, a then-graduate student at Colorado State University (now Affiliate Research Professor at Montana State University) who needed transmitters for tracking fledgling golden eagles. Thus began my initiation into the field of telemetry – transmitter development in our home basement and raptor research on the Pawnee National Grassland working with Al during the summers of his graduate study.

Photo by Jim Watson

VHF transmitters ready to be deployed, circa 1971.

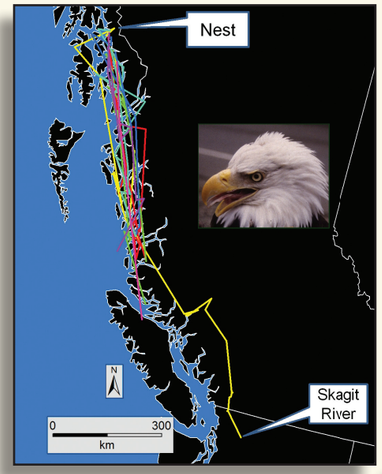
By 1980 avian telemetry was answering research questions at an accelerated pace; transmitters of virtually every weight, power output, and configuration were starting to be manufactured. Would I finally be able to track a rough-legged hawk to its winter destination? I had the opportunity to study rough-legged hawk wintering ecology in southeast Idaho through Montana State University. With the assistance of my wife, Ranae, I was able to track several birds via tail-mounted VHF transmitters from a ground vehicle using a manually operated antenna mast. During occasional aerial flights to search for hawks it was tempting to stray northward to Montana, but flight costs were prohibitive. Hawks returning to winter on the study area were identified with patagial markers for longer tracking because transmitter batteries expired after a few months.

Photo by Jim Watson

Antenna mast atop tracking vehicle.

The frustration, risks, and challenges of tracking raptors long distances with VHF telemetry were experienced by most researchers in those years. After considerable field effort spent capturing and deploying transmitters, the study birds often disappeared quickly without garnering much information on their locations. Al Harmata was one of the few researchers to accomplish that feat, tracking migratory bald eagles from southern Colorado to Canada. I spent the next three years at Oregon State University where we telemetered bald eagles and aerially tracked them over the windswept hills of Columbia River, often losing them without a trace …but thankfully, always returned to solid ground.

Enter the era of avian satellite telemetry, circa 1990. Wildlife researchers were aware of John and Frank Craighead's satellite transmitter development and bear studies in the 1970s. It seemed an unlikely possibility that satellite transmitters could be deployed on birds after we saw those massive bear collars. Little did we know that for several years in the early 1980s a team that included Paul Howey had been developing and testing satellite transmitters on swans and golden eagles. I became aware of their work in the early 1990s when they published the successful satellite tracking of a bald eagle, working with Terry Grubb in Arizona. What did they call the transmitter? A PPT…or was it PTT? What did the acronym mean?



Annual migrations of bald eagle 28017 from 1998-2004 monitored with a 95-g Argos PTT. She was captured on the Skagit River in northwest Washington and nested in southeast Alaska.

As a researcher with the Washington Department of Fish and Wildlife, I initiated a satellite telemetry study on bald eagle migration in the mid-1990s to take advantage of this new technology. The process for public use of the Argos system was just being established, and while the paperwork was deep and the learning curve was steep, the rewards were plentiful. Over the course of 4 years, through funding by the US Fish and Wildlife Service, we monitored 35 adult eagles in Washington with 95g Argos PTTs to identify their movement corridors and identify their origins. We provided the movement data to the online science program "Journey North" for elementary students to track movements of telemetered eagles in near real-time. The advantages of satellite telemetry became obvious quickly: regular transmission of a large number of fixes that were accurate enough to determine flight corridors, monitor mortality, and could be uploaded conveniently via computer. We monitored individual eagles up to 7 years with PTTs that began to give a picture of the dynamics of lifetime movement patterns. Technology rewarded the researchers' push for smaller, lighter transmitters in 2001 and we used the opportunity to combine research with Microwave Telemetry's (MTI's) school program, "Science/Technology in the Classroom."

Photo by Jim Watson

18g solar PTT on Cooper's hawk.

MTI awarded a scholarship to Liberty Bell High School in Twisp, Washington. Working with the students and Kent Woodruff of the Forest Service, we deployed solar Argos PTTs on Cooper's hawks and a northern harrier at Hawkwatch International's Chelan Ridge migration site in north-central Washington. The program provided the students at Liberty Bell High School first-hand research experience by allowing them to handle the raptors and map their latitude and longitude as we tracked them to the Great Basin.

Photo by Jim Watson

Student releasing Cooper's hawk at Chelan ridge.

In the mid-2000s satellite-tracking technology of birds reached another milestone with the ability to acquire global positioning system (GPS) fixes. In 1999, we initiated a study of the wintering ecology of ferruginous hawks to better understand range-use patterns and survival for this state-listed species. Working with the Woodland Park Zoo, Seattle, we deployed Argos PTTs on 13 adult and 15 juvenile hawks. In 2001, Dan Svingen of the Forest Service, and Bob McCready of The Nature Conservancy were intrigued by the tracking results and contacted me about the possibility of expanding this study on an international scale to look at range-wide use patterns. We began using GPS PTTs in 2005. It was quickly apparent that this new technology provided a much better "behavioral" stamp than we could capture from birds with Argos PTTs because the high accuracy of fixes afforded the ability to delineate precise locations and habitat, and acquisition of sensor information on bird flight speed and altitude. In my experience, one of the biggest downsides of remote telemetry has always been the inability to collect behavioral information to complement movement data, that is best gleaned through focal observation of marked or radioed birds. So GPS PTTs provided a good step in that direction. In cooperation with multiple agencies, NGOs, private companies, and universities we have monitored the movements of 72 adult and 52 juvenile hawks since 1999 in on-going research.

Photo by Jim Watson

Juvenile ferruginous hawk with 25g GSM prototype.

The utility of solar GPS satellite technology has become more apparent in our recent investigations of home range and resource use of golden eagles and Buteos related to wind power development that began in 2004. Monitoring long-lived individuals for 5 to 7 years has provided a much better picture of the spatial and temporal dynamics of raptor ecology in the larger landscape compared to short-term (e.g., one year) studies. For golden eagles, this includes our ongoing research to understand potential sources of lead contaminants and wind turbine placement on adult range use (n = 19), as well as mortality factors and survival of juveniles (n = 10). In our cooperative study of Buteos with Oregon Department of Fish and Wildlife, GPS telemetry has been used as the primary tool to understand local movements with the secondary benefit of learning more about their migration.

We are currently testing the efficacy of GSM technology on eagles and Buteos to gather more details about flight behavior and characteristics related to habitat. This technology promises to be a step up in data collection, potentially at reduced costs for data retrieval. We are also working with Northwest Wildlife Consultants, Inc., and testing 5g Argos PTTs on merlins for future research.

Photo by Jim Watson

Merlin with 5g PTT.

As we look to the next generation, technology reaches for even lighter, more powerful, and longer-lived transmitters. In the meantime, the next generation of biologists is preparing to take the reins to test new technologies, including my son Jesse who is studying ferruginous hawks through the University of Alberta and opened his first Argos program earlier this year. So, the cycle continues…oh, and rough-legged hawks? A couple of years ago we finally telemetered three rough-legged hawks with PTTs and tracked them to Alaska.

Photo by Roxanne Shevolup

The next generation; Jesse Watson releasing a GPS-telemetered ferruginous hawk in southern Alberta, 2012.

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